REMARKS

Claim Objections

Claims 1 and 4 were objected to because of the following informalities.

Accordingly, claims 1 and 4 have been amended to overcome the objection.

Rejections under 35 USC §103(a)

Claims 1-7 were rejected under 35 USC §103(a) as being obvious over Shakuda (U.S. Patent No. 5,838,029) in view of Kinoshita et al ("Zirconium Diboride (0001) as an Electrically Conductive Lattice Matched Substrate for Gallium Nitride").

As the independent claim directed to a group III-nitride semiconductor substrate, claim 1 recites "a low-temperature buffer layer consisting of a $B_xAl_yGa_zIn_{1-x-y-z}N$ ($0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $0 \leq 1-x-y-z \leq 1$) single crystal which is grown or deposited on said ZrB_2 single crystal base substantially without creation of any Zr – B – N amorphous nitrided layer caused by the reaction between a nitrogen atom and said ZrB_2 single crystal base."

As the independent claim directed to a method of producing a group III-nitride semiconductor substrate, claims 4 and 6 also recite "a first step of forming a low-temperature buffer layer consisting of $B_xAl_yGa_zIn_{1-x-y-z}N$ ($0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $0 \leq 1-x-y-z \leq 1$), on a ZrB_2 single crystal base having a defect density of 10^7 cm^{-2} or less, at a base temperature allowing said low-temperature buffer layer to be grown or deposited on said ZrB_2 single crystal base substantially without creation of any Zr – B – N amorphous nitrided layer."

According to the method disclosed in Shakuda at column 4, line 15-67, GaN is grown on a single crystalline substrate, and the grown GaN is used as a new substrate after being separated from the substrate. Shakuda describes, at column 4, line 30-31, "It is preferable that the single-crystal semiconductor substrate is made of one member of selected from the group consisting of GaAs, GaP, InP and Si and has a (111) crystal plane . . . ." While the term (111) crystal plane is typically used for cubic crystal structure, ZrB2 is not of cubic crystal but of hexagonal crystal, the plane of which is expressed by a four-digit index such as (1100). Thus, Shakuda discloses technology using crystal different from the present invention.

Moreover, Shakuda describes as follows:

> It is also preferable that the step (g) of growing the gallium nitride type compound semiconductor layer on the single-crystal semiconductor substrate may be implemented by forming the low-temperature buffer layer of the gallium nitride type compound semiconductor layer on the single-crystal semiconductor substrate at low temperature of 400°C to 700°C and forming the gallium nitride type compound semiconductor layer at higher temperature of 700°C to 1200°C so that **the low-temperature buffer layer relaxes the lattice mismatch** between the substrate and the low-temperature buffer layer and prevents crystal defect or dislocation.

(Column 4, lines 35-46). Thus, the low-temperature buffer layer is formed to relax the lattice mismatch. Therefore, the low-temperature buffer layer becomes necessary where there is significant lattice mismatch.

On the other hand, Kinoshita et al describes "Zirconium diboride (ZrB_2) has a hexagonal crystal structure with an in-plane lattice constant of 3.168Å, very close to that of GaN (3.189Å)" (p. L1280, Abstract). Regarding the epitaxial growth, Kinoshita et al describes as follows:

> The (0001) ZrB_2 substrates have sufficient size and quality for preliminary study of III-N heteroepitaxial growth. Suda and Matsunami have investigated molecular beam epitaxial (MBE) growth of GaN on the ZrB_2 substrate mentioned above. Epitaxial growth of GaN on ZrB_2 (0001) was confirmed and its relationship was observed to be in the in-plane lattice-matching direction, i.e., cGaN//cZrB_2 and aGaN//aZrB_2. More recently GaN metal-organic vapor phase epitaxy (MOVPE) has been carried out by Yukawa et al. The dislocation density of GaN grown on the ZrB_2 substrate was less than 1×10^8 cm^{-2}, which is comparable or even superior to that of GaN grown on sapphire. These MBE and MOVPE results clearly indicate that ZrB_2 has the potential to act as a substrate for III-N.

(L1282, left column, last four lines to right column, line 10). Thus, Kinoshita discloses epitaxial growth of GaN directly on ZrB_2 (0001). Kinoshita et al does not mention the necessity of the low temperature buffer layer. Therefore, there is no suggestion or motivation to combine Shakuda and Kinoshita et al.

For at least these reasons, independent claims 1, 4 and 6 patentably distinguish over Shakuda and Kinoshita et al. Claim 3, depending from claim 1, also patentably distinguishes over Shakuda and Kinoshita et al for at least the same reasons.

In view of the aforementioned amendments and accompanying remarks, Applicants submit that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for an interview to expedite the disposition of this case.

If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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